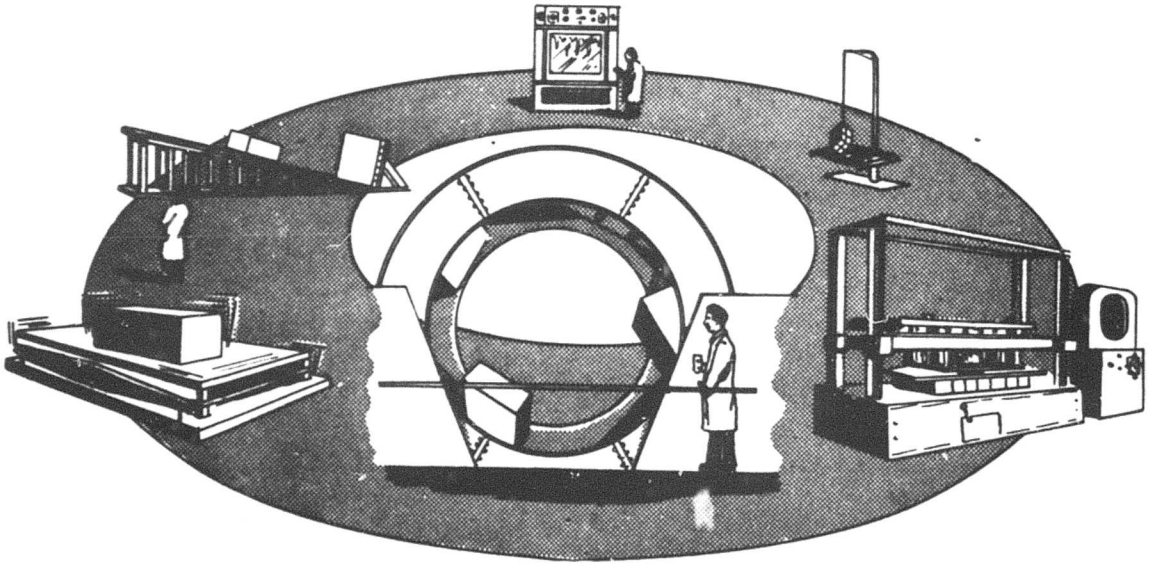
ENGINEERING REPORT NO. 2.5055
PROJECT GROUP NO. NT-003-016(B)

12 May 1953

A method of testing Military Type Fibreboard Boxes to evaluate carton closures



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RESEARCH AND DEVELOPMENT DIVISION
BUREAU OF SUPPLIES AND ACCOUNTS
WASHINGTON, D. C.

TECHNICAL REPORT REVIEW

"A METHOD OF TESTING MILITARY TYPE FIBREBOARD BOXES TO EVALUATE CARTON CLOSURES"

Project No. NT003016(b)
Engr. Report No. 2.5055
12 May 1953

APPROVAL: Report approval 25 August 1953

SECURITY CLASSIFICATION: UNCLASSIFIED

DISTRIBUTION: In accordance with the attached approved distribution list.

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/s/ HERMAN STROCK
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Director, Research and Development Division
By direction of Chief of Bureau

Engineering Report No. 2.5055
(Report # 1)
Project No. NT003-016(b)
12 May 1953

A METHOD OF CYCLIC TESTING

TO

EVALUATE CARTON CLOSURES OF MILITARY TYPE FIBREBOARD BOXES

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ENGINEERING REPORT NO. 2.5055
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A METHOD OF CYCLIC TESTING TO EVALUATE CARTON CLOSURES OF MILITARY TYPE FIBREBOARD BOXES

AUTHORIZATION: ChBuSandA ltr File W23 A11/3 to OinC USNSRDF, Research and Development Project NT003-016(b) Authorization No. SE52-31 (Revision 1) dated 23 April 1952.

PURPOSE: This is an initial report on the first completed phase of a continuing sub-project. The purpose of this report is to present the developed cyclic testing procedure to be used for carton closure evaluation. It is intended that this cyclic test procedure will realistically expose the container closure to the combination of climatic and handling conditions that affects its packaging efficiency.

CONCLUSIONS: The test procedure herein described subjects military type fibreboard boxes on standard test equipment to all phases of handling which might be expected. It appears to be a suitable means for adequately testing glues, tapes, strapping and

other new methods of carton closure by research laboratories. The reproducibility of the test procedure within a laboratory has been affirmed. A large number of V3s, RSC containers have been subjected to the tests with consistent end results.

RECOMMENDATION: It is recommended that the stated test procedure be used as a test for the military type fibreboard boxes complying with Joint Army-Navy Specification JAN-P-108. This test procedure, because of the time and equipment needed, is not intended to replace any or all of the tests required by JAN-P-108. The tests are recommended for use only by research laboratories to establish performance criteria for fibreboard boxes with alternative designs. Boxes with standard types and new types of closures, strappings, tape reinforcings, or composed of new types of fibreboard should be tested by research laboratories using this procedure to evaluate and improve the general and detail requirements of JAN-P-108.

I SCOPE

A group of containers, when tested to failure or near failure by means of any one test, cannot possibly satisfactorily predict actual field conditions or performance. Each of these specific tests are intended to give indications of container performance in only their own specific fields, i.e., drop test, compression test, vibration test, etc. Therefore, each test in itself presents only its own one force or hazard to which a container is subjected, and not an overall picture of actual container damage.

In order to meet the great variety of conditions which packages are subjected to from the time they are initially packed until they reach their final destination, they must be highly resistant to extremes of heat and cold, the deteriorative effect of water, rough handling, extreme vibration in transit over rough roads and seas, and storage under the most adverse conditions. Thus, the damages to a container vary, and, more important, the damages they sustain are cumulative. That is, each condition, or force or hazard which a container encounters in its "lifetime" has a marked effect left on it which thereafter will influence its strength, usefulness and durability.

In a like manner must the testing of containers be subjected to such conditions, forces and hazards ---- and, most important, in a way that will inflict these damages one right after another, cumulatively, in the same way as they are incurred in actuality. For, in order to accurately simulate actual field conditions, all factors must be brought into considera-

tion. The cumulative effect is the one which has been neglected heretofore, and is now introduced for greater accuracy in the testing of military type fibreboard boxes.

II APPARATUS

The test equipment and apparatus will conform to the following specifications:

A. Drop Test Apparatus - "Any suitable apparatus may be used that conforms to the following requirements:

(1) Permits accurate prepositioning of the container to assure a true fall and impact at the exact places and in the direction desired,

(2) Permits accurate and convenient control of the height of drop,

(3) Facilitates handling and elevation of the containers.....

.....,

(4) Utilizes lifting devices that will not damage the containers,

(5) Permits an absolutely free, unobstructed fall,

(6) Provides for variations in height of drops within limits of anticipated requirements, and

(7) Provides a solid surface of concrete, stone or steel of sufficient mass to absorb all shock without deflection." See Figure 1.

A.S.T.M. Designation: D 775-47, Standard Method of Drop Test for Shipping Containers.

B. Compression Test Apparatus - "A compression testing machine of accepted design and capacity. It shall be calibrated in accordance with the Tentative Methods of Verification of Testing Machines (A.S.T.M. Designation: E 74-47T)....." See Figure 2.

A.S.T.M. Designation: D 642-47, Standard Method of Compression Test for Shipping Containers.

C. Revolving Hexagonal Drum - "The testing machine consists of a revolving drum which shall be the form of a geometrical prism, ... whose bases are regular hexagons and whose lateral faces are rectangles. The axis of revolution shall be horizontal. Baffles or hazards shall be fixed on the inside faces of the drum ..... The inner faces of the drum shall be clean, smooth, and polished bright (Note). The drum shall be equipped with an automatic counting device which will record six drops for each revolution.

Note - Wax is recommended to protect against rust when not in use". See Figure 3.

A.S.T.M. Designation: D 782-47, Standard Method of Test for Shipping Containers in Revolving Hexagonal Drum.

D. Vibration Test Apparatus - "The apparatus shall consist of a table of suitable size and weight-carrying capacity, supported on one or more eccentrics or cranks which shall be driven by shafts

so as to give the table a circular harmonic vibratory motion in a vertical plane. The apparatus shall be capable of being operated at a speed or speeds designed to produce the vibration frequencies experienced in transportation. Side rails and a low fence may be provided so that the test object will not creep off the table during operation". See Figure 4.

A.S.T.M. Designation: D 999-48T, Tentative Method of Vibration Test for Shipping Containers.

E. Incline Impact Test Apparatus - "The principal apparatus consists of a two-rail steel track inclined ten degrees from the horizontal, a rolling carriage or dolly, and a rigid bumper. The bumper shall be a wood barrier constructed at the bottom of the incline, with the plane of the face perpendicular to the direction of movement of the carriage .. .. The track shall accommodate the flat-bed rolling carriage or dolly which is equipped with steel wheels and a renewable wood or plywood face. The wood faces of the carriage and the bumper shall be maintained free of prominent projections which may affect the test results, such as bolt or nail heads, scores, abrasions, and splits. The track shall be clean and the wheels well lubricated..... ..... The wheels shall be not less than three inches in diameter". See Figure 5.

A.S.T.M. Designation: D 880-47, Standard Method of Incline Impact Test for Shipping Containers.

F. Conditioning Room Test Apparatus - The apparatus will consist of a conditioning room or rooms that can be accurately controlled to temperature variations of -10°F. to 130°F. and relative humidity variations of less-than 10% to 100%, or any such apparatus that will give temperatures and relative humidities of; 0°F. to -10°F. at less-than 10% R.H., 65°F. to 75°F. at 45% to 50% R.H., 70°F. to 90°F. at less-than 10% R.H., and 120°F. to 130°F. at 95% to 100% R.H.

G. Water Spray Test Apparatus - Use spray nozzles, of such size and so spaced that two gallons of water per hour will fall uniformly distributed on each square foot of floor area, and so located that the spray has a minimum free fall of five feet when it hits the test containers.

III TEST CONTAINERS

A. The containers being tested will be complete in all respects. Interior packing may or may not be used, depending upon the specifications for the material packed. The containers may be packed with either the actual contents or with a dummy load perfectly simulating the contents. The packed containers will be closed, strapped or sealed in exactly the same manner as they will be for actual shipment.

B. The containers will be boxes, constructed from military type fibreboard, known as V-board and W-board.

C. The test containers will be marked for identification according

to the following procedure: "Facing one end of the container, with the manufacturer's joint on the observer's right....., designate the top of the container as 1, the right side as 2, the bottom as 3, the left side as 4, the near end as 5, and the far end as 6. Identify the edges by the numbers of the two faces that form the edges, for example, 1-2 identifies the edge formed by the top and the right side, and 2-5 the edge formed by the right side and the near end. (The latter is the edge having the manufacturer's joint, ...). Identify the corners by the numbers of the three faces that meet to form that corner; for example, 1-2-5 identifies the corner where the top, the right side, and the near end meet". See Figure 6.

A. S. T. M. Designation: D 775-47, Standard Method of Drop Test for Shipping Containers.

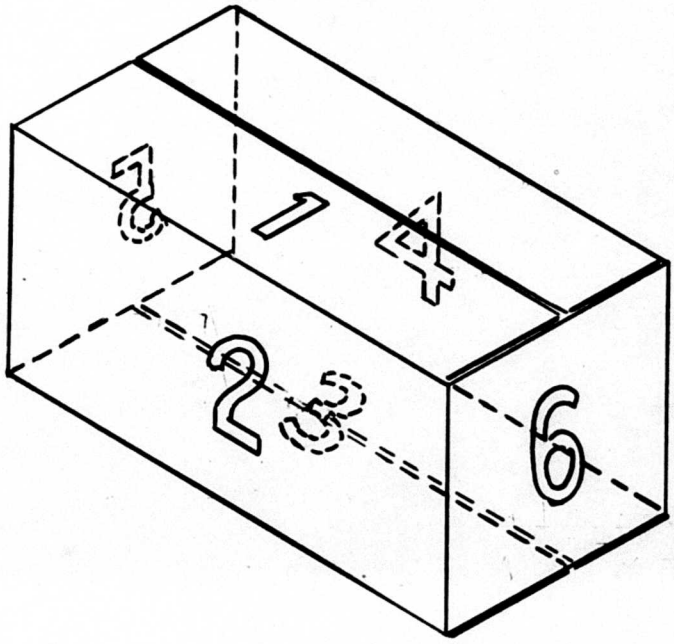


Figure 6 - Identification Markings

IV NUMBER OF TESTS

Performance normally should be based on tests of not less than five, but preferably ten, identical representative specimens of a given size and weight, to obtain an average result.

V TEST PROCEDURE

A. Cyclic Exposure Test - The containers will initially undergo the following tests in the stated sequence:

(1) Two hour exposure to a temperature of 120°F. to 130°F. at 95% to 100% R.H.,

(2) Two hour exposure to a temperature of 70°F. to 90°F. at less-than 10% R.H.,

(3) Two hour exposure to a temperature of -10°F. to 0°F. at less-than 10% R.H.,

(4) Two hours of a tap water spray at approximately 60°F.,

(5) Forty hour exposure to a temperature of 65°F. to 75°F. at 45% to 50% R.H.

B. Cyclic Strength Test - Immediately following the cyclic exposure test, the test containers will be subjected to the following sequence:

(1) Drop Test - the container will be dropped from a height of eighteen inches above the striking base on corner 1-2-5 and then on corner 3-4-6, (only these two corners will be subjected to the drop test throughout the entire test

procedure),

(2) Compression Test - the minimum compressive force, applied face to face, which the container will support, will be determined according to the following formula:

$$\text{Compr. Force} = \text{Wt. of Ctn.} \times \frac{\text{Max. Height of Stacking}}{\text{Height of Container}} \times 3.0.$$

Where:

Compr. Force = pounds

Wt. of Ctn. = pounds

Max. Height of Stacking = feet

Height of Ctn. = feet

The factor of 3.0 takes into account the increased compressive load that will be applied to the container due to vertical accelerations.

(3) Revolving Drum Test - the container will be placed in the crotch of the hazard on face No. 1 of the drum with the top face 1 of the container upward and with end 5 and side 2 against the sides of the hazard. The drum will then be started in motion and stopped when the container has sustained 6 falls, (one revolution).

(4) Vibration Test - the container will be placed on the vibration table without any fastening. The table will then be started in motion at a speed that will result in forces

equivalent to one times gravity acting on the container. The test will be continued for fifteen minutes, and then it will be stopped.

(5) Incline Impact Test - the container will be placed on the dolly with side 2 facing toward the bumper and top face positioned upward. The container will be so positioned on the dolly that side 2 will project 1 inch beyond the forward end of the dolly. The container will be backed by a dead weight which will be determined by the following formula:

$$\text{Dead Weight} = \text{Wt. of Container} \times \left(\frac{7.5 \text{ feet}}{\text{Length of Container}} - 1 \right)$$

The dolly will be brought up to that position which will inflict a 6 mph impact on the container, and then it will be released.

(6) Revolving Drum Test - repeat Step #3, above.

(7) Drop Test - repeat Step #1, above.

(8) Compression Test - repeat Step #2, above.

Repeat Steps 1-8, above, until a specified predetermined number of cycles, estimated to be equivalent to rough handling in actual service, have been given the container, or until failure has occurred. Failure may be considered to have occurred when:

(a) contents are fully exposed,

(b) contents spill from container,

(c) one edge breaks open along three-fourths of its entire length

(d) two or three edges combined, which make up a corner, break open along one-quarter of the entire length of each edge.

(e) any part of the contents may be removed from the container without damaging it further,

(f) some other predetermined type of damage has occurred.

VI REPORT

The report will include the following:

(1) The inside and overall dimensions of the container under test; its complete structural specifications; kind of material; description and specifications for reinforcing; blocking and cushioning, if used; spacing; size and kind of fasteners; method of closing and strapping; and the net and gross weights.

(2) A complete description of the contents of the container and the inner packing materials, including arrangement and fit.

(3) A detailed record of the tests on each container, including the damage sustained by each container and its contents and when and where it occurred. Any other

observations which may assist in correctly interpreting the results should also be included.

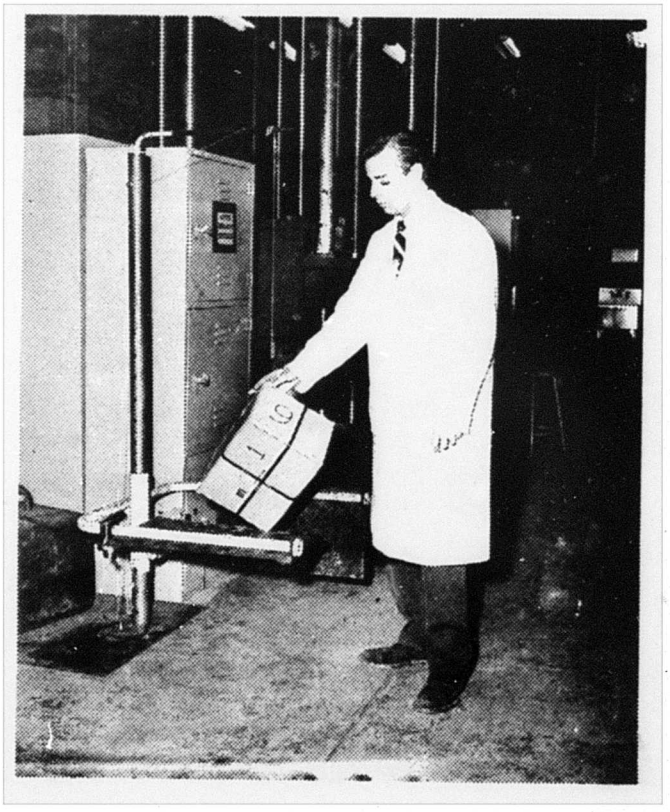
(4) A description of the types of apparatus used for each test.

(5) A statement to the effect that all tests were made in full compliance with this method.

Figure 1.

Drop Test ---- The purpose of this test is to determine the ability of a container to withstand rough handling, sudden shock and distortion. The test consists of releasing a container from a specified height onto a flat, rigid metal base or concrete floor. The container must be carefully suspended at the proper angle to insure a true, free, vertical drop in the specified position.

There are a number of drop test devices which may be employed for this test. The device illustrated is a divided table or split platform type, which opens at the center when tripped.



Neg. No. 17-2

Figure 2.

Compression Test ---- The purpose of this test is to measure the ability of a container to resist external compressive loads applied to its faces. A specified compressive force is applied top to bottom between the two parallel faces of the machine.

The apparatus used for making the compressive tests consists basically of a platform scale over which a power-driven cross-beam is mounted. As the cross-beam descends upon the container, the compressive forces are applied.

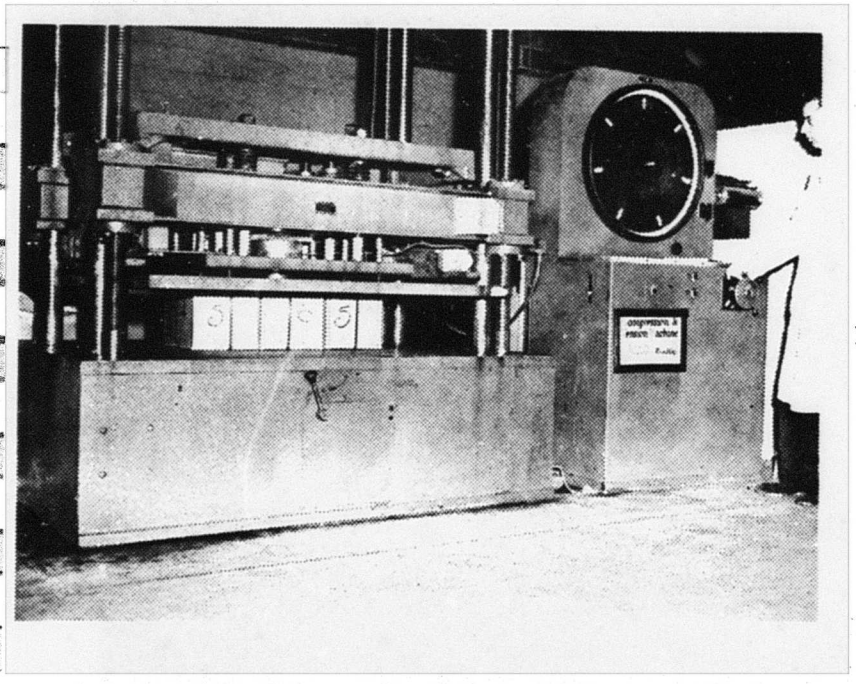


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Figure 3.

Revolving Drum Test ---- The purpose of this test is to determine the ability of a container to withstand rough handling. The inside of the drum has six faces upon which baffles, guides and obstructions are so arranged as to cause a container to slide, turn and fall on its faces, edges and corners as the drum slowly revolves.

The picture is of a 14-foot revolving drum which rotates at a rate of one revolution per minute.

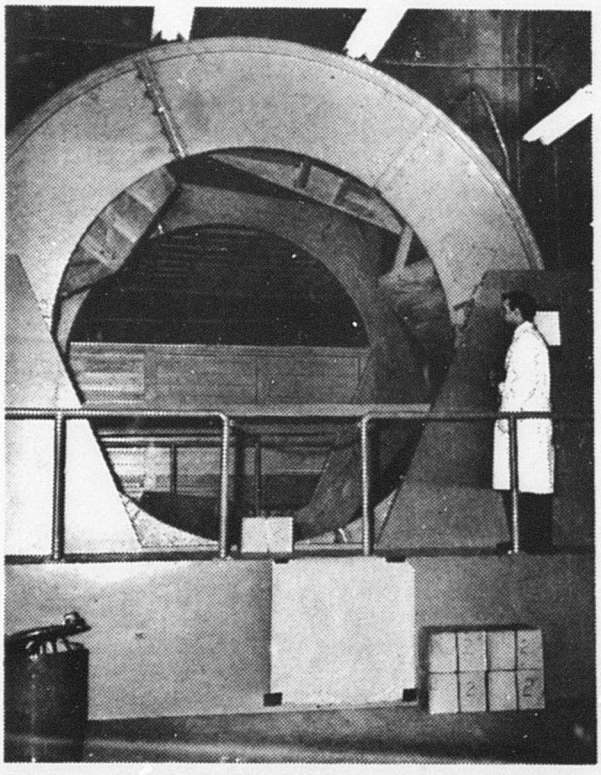

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Figure 4.

Vibration Test ---- The purpose of this test is to determine the ability of a container to withstand the shocks and vibrations of transportation. For this test, the vibration machine has been set to be eccentrically driven by two shafts to produce a circular, harmonic vibratory motion. The machine's amplitude has been also set so as to be fixed, but the rate of vibration or speed has been left to be adjustable. A container is placed on the machine and a predetermined speed is maintained for a specified period of time.

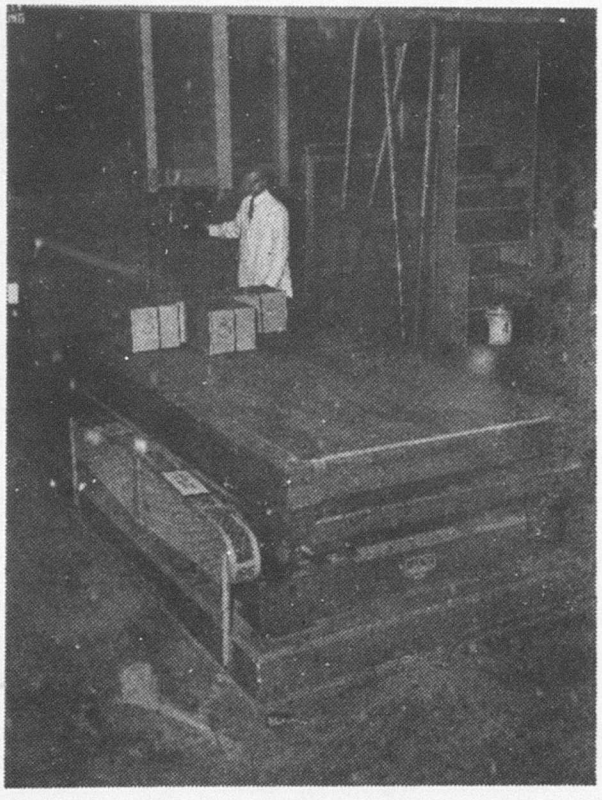

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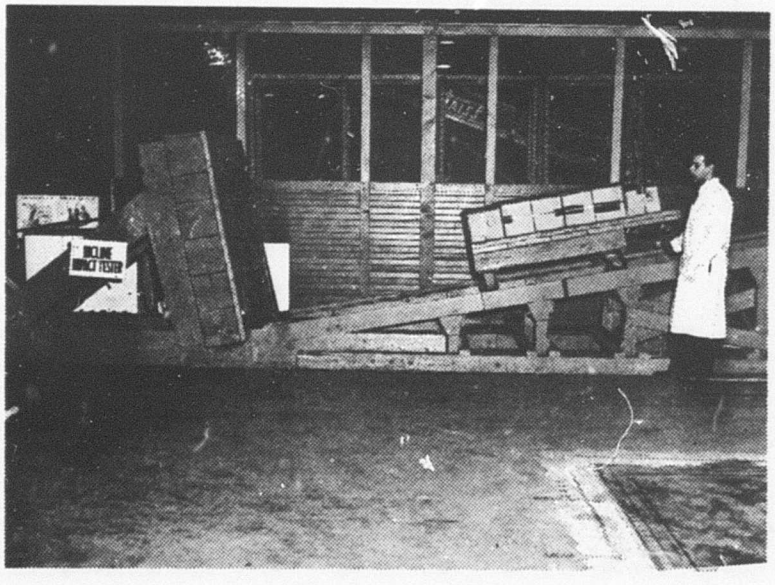
Figure 5.

Incline Impact Test ---- The purpose of this test is to determine the ability of a container to withstand impact stresses. The apparatus consists of a pair of tracks inclined 10 degrees, with a sturdy bumper located at the bottom. A dolly, which rolls on the tracks, carries a container which is to be tested. The loaded dolly is released at a predetermined distance and allowed to roll freely down the incline until stopped by the bumper.



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